Information about GB Non-native Species Risk Assessments

The Convention on Biological Diversity (CBD) emphasises the need for a precautionary approach towards non-native species where there is often a lack of firm scientific evidence. It also strongly promotes the use of good quality risk assessment to help underpin this approach. The GB risk analysis mechanism has been developed to help facilitate such an approach in Great Britain. It complies with the CBD and reflects standards used by other schemes such as the Intergovernmental Panel on Climate Change, European Plant Protection Organisation and European Food Safety Authority to ensure good practice.

Risk assessments, along with other information, are used to help support decision making in Great Britain. They do not in themselves determine government policy.

The Non-native Species Secretariat (NNSS) manages the risk analysis process on behalf of the GB Programme Board for Non-native Species. Risk assessments are carried out by independent experts from a range of organisations. As part of the risk analysis process risk assessments are:

- Completed using a consistent risk assessment template to ensure that the full range of issues recognised in international standards are addressed.
- Drafted by an independent expert on the species and peer reviewed by a different expert.
- Approved by an independent risk analysis panel (known as the Non-native Species Risk Analysis Panel or NNRAP) only when they are satisfied the assessment is fit-for-purpose.
- Approved for publication by the GB Programme Board for Non-native Species.
- Placed on the GB Non-native Species Secretariat (NNSS) website for a three month period of public comment.
- Finalised by the risk assessor to the satisfaction of the NNRAP.

To find out more about the risk analysis mechanism go to: www.nonnativespecies.org

Common misconceptions about risk assessments

To address a number of common misconceptions about non-native species risk assessments, the following points should be noted:

- Risk assessments consider only the risks posed by a species. They do not consider the practicalities, impacts or other issues relating to the management of the species. They therefore cannot on their own be used to determine what, if any, management response should be undertaken.
- Risk assessments are about negative impacts and are not meant to consider positive impacts that may also occur. The positive impacts would be considered as part of an overall policy decision.
- Risk assessments are advisory and therefore part of the suite of information on which policy decisions are based.
- Completed risk assessments are not final and absolute. Substantive new scientific evidence may prompt a re-evaluation of the risks and/or a change of policy.

Period for comment

Draft risk assessments are available for a period of three months from the date of posting on the NNSS website*. During this time stakeholders are invited to comment on the scientific evidence which underpins the assessments or provide information on other relevant evidence or research that may be available. Relevant comments are collated by the NNSS and sent to the risk assessor. The assessor reviews the comments and, if necessary, amends the risk assessment. The final risk assessment is then checked and approved by the NNRAP.

*risk assessments are posted online at:
https://secure.fera.defra.gov.uk/nonnativespecies/index.cfm?sectionid=51
comments should be emailed to nnss@fera.gsi.gov.uk

GB NON-NATIVE ORGANISM RISK ASSESSMENT SCHEME

For more information visit: www.nonnativespecies.org

	Name of Organism	***Elodea nuttallii* - Nuttall's Pondweed**
	Objectives:	Assess the risks associated with this species in GB
	Version:	Original draft 22/02/11
	Author:	D. Simpson (Kew) and M. Duenas (CEH)
	Suggested citation:	Simpson and Duenas (2011). GB Non-native Organsim Risk Assessment for *Elodea nutallii.* www.nonnativespecies.org

N	QUESTION	RESPONSE	COMMENT
1	What is the reason for performing the Risk Assessment?		Request by the GB Programme Board for Non-native Species
2	What is the Risk Assessment area?	GB	
3	Does a relevant earlier Risk Assessment exist?	NO OR UNKNOWN (Go to 5)	
4	If there is an earlier Risk Assessment is it still entirely valid, or only partly valid?		
A	**Stage 2: Organism Risk Assessment SECTION A: Organism Screening**		
5	Identify the Organism. Is the organism clearly a single taxonomic entity and can it be adequately distinguished from other entities of the same rank?	YES (Give the full name & Go to 7)	*Elodea nuttallii* (Planch.) St John. Hydrocharitaceae. Horticultural and vernacular names: Nuttall's pondweed, Western waterweed (USA), Tím uisce chaol (Irish), Alaw Nuttall (Welsh). *Elodea nuttallii* (Planch.) H.St.John (1920) is a single taxonomic entity belonging to Family Hydrocharitaceae. In Europe, Elodea species can be distinguished from all other aquatic and plants except Egeria densa and Hydrilla verticillata by their whorls of undivided leaves, which lack a sheathing base but have a single central vein and small marginal teeth. Egeria densa can be distinguished from Elodea by its generally much larger size, the presence of small teeth along the central vein on the leaves and by the nature of the teeth on the leaf margins. Lagarosiphon major has very strongly recurved leaves and these are in spirals, whereas those of Elodea are in whorl. (Lansdown 2008). Determination of sterile Elodea species has also been an area of controversy in Europe. The leaves are either linear or linear-lanceolate and the shape of the leaf apex is narrowly acute to acuminate in E. nuttallii's European populations (Thiébaut and Nino, 2009); and the determination keys should emphasize the difficulties of distinguishing plants with long plane leaves vegetatively (Vanderpoorten et al. 2000).
6	If not a single taxonomic entity, can it be redefined?		
7	Is the organism in its present range known to be invasive, i.e. to threaten species, habitats or ecosystems?	YES (Go to 9)	Known to be invasive in all areas where present outside its native range, including parts of Europe and Japan. In the UK it was first recorded in 1966 and it has shown a steady increase since then. It has now ben recorded from 1052 x 10 km grid squares. It has frequently displaced *Elodea canadensis* although recently *Lagarosiphon major* has been recorded as displacing *Elodea nuttallii*.
8	Does the organism have intrinsic attributes that indicate that it could be invasive, i.e. threaten species, habitats or ecosystems?	YES or UNCERTAIN (Go to 9)	*Elodea nuttallii is* a rhizomatous, perennial, submerged, aquatic plant. It is present in freshwater lakes and ponds, reservoirs and slow-moving streams and canals, often forming dense mats. Dense growth of *Elodea nuttallii* can block light penetration into water bodies, reducing or eliminating native water plants and affecting associated populations of aquatic invertebrates. Dense growth can affect recreation activities, especially boating, watersports or angling. It reproduces by small pieces of stem breaking off a plant which rapidly grow to form new plants - indeed every node is capable of producing a new plant. It overwinters as prostrate shoots with strongly recurved green leaves, forming dense mats on the bottom substrate of a water body. Growth recommences as soon as the temperature rises again. The comment must focus on the traits of the species that indicate that it is invasive rather than describe the environmental impacts. The species shows typical invader traits: high plasticity, rapid growth, vegetative reproduction through fragments and easily dispersed by waterfowl and currents (Cook and Urmi- König, 1985; Nichols and Shaw 1986; Cook 1987). E. nuttallii should be regarded as having a high risk of being invasive (Thiébaut et al. 1997; Barrat-Segretain 2001) and It can cause major problems by blocking pipes; strongly invaded waters lose their attractiveness and safety for recreation. Flooding may be caused by heavy infestations choking drainage systems and sluices.
9	Does the organism occur outside effective containment in the Risk Assessment area?	YES (Go to 10)	Widely established and distributed outside any effective containment.

10	Is the organism widely distributed in the Risk Assessment area?	YES & Future conditions/management procedures/policies are being considered (Go to 19)		Overall, *Elodea nuttallii* is common and widespread over England up to a line roughly between the Ribble and Humber estuaries. Further north it is frequent in Lancashire and Cumbria but is absent from much of central northern and north-eastern England. In Wales its distribution is focused on mid-western and south-eastern parts of the country with sporadic occurrences elsewhere. In Scotland it occurs mostly in the south west and in the Central Lowlands. There is one record from North Uist and scattered records around the Moray Firth and Ballachulish but is otherwise absent from the Highlands and Islands (see distribution map at http://data.nbn.org.uk/gridMap/gridMap.jsp?allDs=1&srchSpKey=NHMSYS0000458329). *Elodea nuttallii* occupies similar habitats to *E. canadensis* and spread to any unoccupied area or one currently occupied by *E. canadensis* cannot be ruled out.
11	Does at least one species (for herbivores, predators and parasites) or suitable habitat vital for the survival, development and multiplication of the organism occur in the Risk Assessment area, in the open, in protected conditions or both?			
12	Does the organism require another species for critical stages in its life cycle such as growth (e.g. root symbionts), reproduction (e.g. pollinators; egg incubators), spread (e.g. seed dispersers) and transmission, (e.g. vectors)?			
13	Is the other critical species identified in question 12 (or a similar species that may provide a similar function) present in the Risk Assessment area or likely to be introduced? If in doubt, then a separate assessment of the probability of introduction of this species may be needed.			
14	Does the known geographical distribution of the organism include ecoclimatic zones comparable with those of the Risk Assessment area or sufficiently similar for the organism to survive and thrive?			
15	Could the organism establish under protected conditions (e.g. glasshouses, aquaculture facilities, terraria, zoological gardens) in the Risk Assessment area?			
16	Has the organism entered and established viable (reproducing) populations in new areas outside its original range, either as a direct or indirect result of man's activities?			
17	Can the organism spread rapidly by natural means or by human assistance?			
18	Could the organism as such, or acting as a vector, cause economic, environmental or social harm in the Risk Assessment area?			
19	This organism could present a risk to the Risk Assessment area and a detailed risk assessment is appropriate.	Detailed Risk Assessment Appropriate GO TO SECTION B		
20	This organism is not likely to be a harmful non-native organism in the Risk Assessment area and the assessment can stop.			
B	**SECTION B: Detailed assessment of an organism's probability of entry, establishment and spread and the magnitude of the economic, environmental and social consequences**			As indicated above the plant is already widely established, especially in England. This risk assessment should, therefore, aim to assess future spread. However, for completeness, comments on the probability of entry and establishment are made.
	Probability of Entry	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.1	List the pathways that the organism could be carried on. How many relevant pathways can the organism be carried on?	many - 3	LOW - 0	Horticultural trade; aquarium trade; disposal of cultivated material; natural spread from habitats where already present. Unintentional introductions: a) habitat alteration/canals; b) recreational activities. Intentional introductions: c) as ornamental plants in aquariums/ponds/amenities, via the trade in live aquarium plants and its disposal near waterways. This must be considered to be the principal pathway.
1.2	Choose one pathway from the list of pathways selected in 1.1 to begin the pathway assessments.	Horticultural trade		
1.3	How likely is the organism to be associated with the pathway at origin?	very likely - 4	LOW - 0	Deliberate trade of *Elodea nuttallii* occurs in its the native range (USA and Canada). It is considered to be 'Threatened' in Kentucky and of 'Special Concern' in Tennessee. Annual sales of Nuttalls waterweed, along with Canadian waterweed and curly waterweed, amount to between £2m and £5m. (Keith Davenport pers. comm. In Davis, 2009)

1.4	Is the concentration of the organism on the pathway at origin likely to be high?	moderately likely - 2	LOW - 0	Deliberate trade, although nowadays not traded as much as some similar species such as *Lagarosiphon major* .
1.5	How likely is the organism to survive existing cultivation or commercial practices?	very likely - 4	LOW - 0	The plant easily survives in cultivation.
1.6	How likely is the organism to survive or remain undetected by existing measures?	likely - 3	LOW - 0	Would be easily seen when established during the growing season. However, small fragments would not be easily detected. It can be confused with other similar species and remain undetected during winter (in sediment).
1.7	How likely is the organism to survive during transport /storage?	very likely - 4	LOW - 0	
1.8	How likely is the organism to multiply/increase in prevalence during transport /storage?	unlikely - 1	MEDIUM -1	Some growth may occur during transport. Fragmentation of plants during storage may encourage spread when plants are released.
1.9	What is the volume of movement along the pathway?	moderate - 2	LOW - 0	Easy to grow but seems to be less popular in trade than *Lagarosiphon major* .
1.10	How frequent is movement along the pathway?	occasionally - 2	MEDIUM -1	The lower popularity of this plant in trade may mean that movement is less frequent.
1.11	How widely could the organism be distributed throughout the Risk Assessment area?	very widely - 4	LOW - 0	The current distribution of the plant in the risk assessment area is wide (see distribution map at http://data.nbn.org.uk/gridMap/gridMap.jsp?allDs=1&srchSpKey=NHMSYS0000458329)
1.12	How likely is the organism to arrive during the months of the year most appropriate for establishment ?	very likely - 4	LOW - 0	Because the plant dies back during the winter, it is most likely to available for trade, and disposal into the natural environment, during the summer months.
1.13	How likely is the intended use of the commodity (e.g. processing, consumption, planting, disposal of waste, by-products) or other material with which the organism is associated to aid transfer to a suitable habitat?	very likely - 4	LOW - 0	Fragments of the plant from disposal of aquarium or pond contents into the natural environment could aid transfer. It has spread by escaping from garden ponds and through the disposal of garden waste near waterways (Preston and Croft, 1997).
1.14	How likely is the organism to be able to transfer from the pathway to a suitable habitat?	very likely - 4	LOW - 0	Historically assumed that the transfer from horticulture/cultivation into natural habitats has aided the current widespread distribution of *Elodea nuttallii.*
	Probability of Establishment	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
1.15	How similar are the climatic conditions that would affect establishment in the Risk Assessment area and in the area of current distribution?	similar - 3	LOW - 0	Climatic conditions are similar between the native North American range and the UK. There seem to be no limiting climatic factors.
1.16	How similar are other abiotic factors that would affect establishment in the Risk Assessment area and in the area of present distribution?	similar - 3	LOW - 0	See 2.4
1.17	How many species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism species are present in the Risk Assessment area? Specify the species or habitats and indicate the number.	very many - 4	LOW - 0	*Elodea canadensis* has been recorded from 1052 x 10 km grid squares in the UK indicating a range of suitable habitats.
1.18	How widespread are the species (for herbivores, predators and parasites) or suitable habitats vital for the survival, development and multiplication of the organism in the Risk Assessment area?	widespread - 4	LOW - 0	Widespread - see 2.4.
1.19	If the organism requires another species for critical stages in its life cycle then how likely is the organism to become associated with such species in the risk assessment area?	very unlikely - 0	LOW - 0	There is no evidence to suggest that the species requires any other method for critical stages in its life cycles.
1.20	How likely is it that establishment will not be prevented by competition from existing species in the Risk Assessment area?	very likely - 4	LOW - 0	Native aquatic plant species are generally outcompeted by *Elodea nuttallii.* However, other introduced species, especially *Lagarosiphon major,* may outcompete *E. nuttallii.* Where it establishes it can form exceptionally dense monocultures, excluding native species through competition.
1.21	How likely is it that establishment will not be prevented by natural enemies already present in the Risk Assessment area?	likely - 3	LOW - 0	Elodea species are often preferred food for waterfowl or crayfish (Lodge 1991; van Donk and Otte 1996). There are no natural enemies in the RA area. E. nuttalli is relatively palatable (Elger and et al., 2004) due to its high content of allelochemicals (Newman 1991; Lemoine et al., 2009), which are active against competing algae and cyanobacteria (Erhard and Gross 2006; Wu et al, 2009). The chemical defence in E. nuttallii is a powerful trait to protect the plants against herbivores and might further strengthen the invasiveness of this species (Erhard,et al 2007).
1.22	If there are differences in man's management of the environment/habitat in the Risk Assessment area from that in the area of present distribution, are they likely to aid establishment? (specify)	very likely - 4	LOW - 0	Management practices, such as mechanical harvesting, may give rise to small plant fragments which would aid establishment. Mechanical control will increase fragmentation of the plant, to aid establishment, overall if the cutting is done at the end of the season (Newman, 2009).
1.23	How likely is it that existing control or husbandry measures will fail to prevent establishment of the organism?	likely - 3	LOW - 0	Already widely established and mechanical control techniques further aid establishment.
1.24	How often has the organism been recorded in protected conditions, e.g. glasshouses, elsewhere?	frequent - 3	LOW - 0	Grown in plant nurseries, garden ponds.
1.25	How likely is the reproductive strategy of the organism and duration of its life cycle to aid establishment?	very likely - 4	LOW - 0	The plant reproduces vegetatively in the risk assessment area. All plants are believed to be female. No male plants have been recorded in the UK or in other areas of introduction in Europe. Growth of new plants from a single node or small fragments is a very effective reproductive strategy.

1.26	How likely is it that the organism's capacity to spread will aid establishment?	likely - 3	LOW - 0	The current widespread distribution is indicative of how well it can become established.
1.27	How adaptable is the organism?	very adaptable - 4	LOW - 0	The plant can grow in a range of conditions in the UK (See 2.4). Waterweeds are highly adaptable to a broad array of environmental conditions (Cook and Urmi-König 1985; Simpson 1990). It is able to grow in turbid, highly eutrophic waters (Cook & Urmi-König 1985, Ozimek et al. 1993, Thiébaut & Muller 1999), as well as in clear oligo-mesotrophic waters (Thiébaut et al. 1997, Barrat-Segretain 2001, Nagasaka 2004) with a certain degree of organic pollution (Best, et al., 1996). It is tolerant of disturbance, oil pollution and is typically found in calcareous water, from fresh to slightly brackish coastal water (St. John 1965) up to 14 parts per thousand of salinity, and in fine sediment soil, where it is particularly successful.
1.28	How likely is it that low genetic diversity in the founder population of the organism will not prevent establishment?	very unlikely - 0	LOW - 0	Low genetic diversity has not prevented widespread establishment in the UK over a 43 year period.
1.29	How often has the organism entered and established in new areas outside its original range as a result of man's activities?	many - 3	LOW - 0	All introductions into continents outside North America are due to Man's activities. Subsequent spread has been due to a combination of Man's activities and natural means of spread. E. nuttallii was reported in Europe in Belgium in 1939 (with a definite identification in 1955) (Simpson, 1984); and in Britain in 1966, and spreading rapidly from 1970 onwards from the southeast and scattered throughout Wales, Scotland (Preston and Croft, 1997) and Ireland in 1984. It was also reported in the Netherlands in 1941, and in Germany in 1961, where it has since spread across the country. There are also reports of finds in Denmark (1974) (DAISIE, 2009), in Switzerland, where it was reported in the 1980s, and is spreading along the Rodan (Rhone) river (CPS-SKEW, 2008). It was first found in Sweden in 1991, in Lake Mälaren (Anderberg, 1992) and, together with E. Canadensis and Nymphoides peltata. Thereafter, its spread was noted in 1998 in the Danube delta in Romania, covering the majority of the delta (Sârbu et al., 2006); and from there to Slovakia in 2001 (Oťaheľová and Valachovič, 2002) and Hungary (Mesterházy et al., 2009) and then spreading into Western Europe (Wittenberg, 2005; Branquart, 2007). It is not unlikely that additional finds have been made, but that they have been mistaken for Canadian waterweed. In Asia, it was reported for the first time in 1960 in Japan (Lake Biwa) (Ikushima and Kabaya 1965). It has been reported in China around the 1980s.
1.30	How likely is it that the organism could survive eradication campaigns in the Risk Assessment area?	very likely - 4	LOW - 0	Given that the plant can grow from a single node, great care would be needed to ensure complete eradication.
1.31	Even if permanent establishment of the organism is unlikely, how likely is it that transient populations will be maintained in the Risk Assessment area through natural migration or entry through man's activities (including intentional release into the outdoor environment)?	N/A	LOW - 0	The plant has been established for 43 years and shows every sign of now being permanantly established.
	Spread	**RESPONSE**	**UNCERTAINTY**	**COMMENT**
2.1	How rapidly is the organism liable to spread in the Risk Assessment area by natural means?	intermediate - 2	MEDIUM -1	In the risk assessment area the plant exclusively reproduces vegetatively through small pieces of stem which break off from the main plant. These may be carried to new habitats by birds or mammals. Fragments have high survival rates which allow them to be dispersed over long distances, therefore increasing their invasion capabilities. Different studies have established that E. nuttallii is probably in an expansion phase in Europe and is likely to spread to new areas (Simpson 1984; Thiébaut et al. 1997; Barrat-Segretain 2001, Larson 2007), and it should be regarded as having a high risk of being invasive.
2.2	How rapidly is the organism liable to spread in the Risk Assessment area by human assistance?	rapid - 3	LOW - 0	Boats, fishing lines - the plant reproduces vegetatively from small pieces of stem that rapidly produce roots and grow into new plants. Garden ponds and aquaria are likely to be sources of new plants.
2.3	How difficult would it be to contain the organism within the Risk Assessment area?	difficult - 3	LOW - 0	The plant is so widely established that it is effectively beyond containment. It could be very difficult, but measures can be taken to contain it. It must be strongly recommended as a priority target for eradication or control in new sites (Thiébaut et al. 1997; Barrat-Segretain 2001).
2.4	Based on the answers to questions on the potential for establishment and spread define the area endangered by the organism.		LOW - 0	*Elodea nuttallii* occurs on fine substrates at c. 0.1-4 m depth, rarely more, in unshaded, eutrophic to meso-oligotrophic water-bodies, where turbulence through water-flow or wave action is minimal. It is most frequently found in lowland ponds, lakes, canals, slow-moving rivers and streams. It is sometimes found in slightly brackish coastal waters and tidal flats, tolerating salinities of up to 14.4 ppt, about half normal sea water. It is also tolerant of disturbance, and oil pollution. Growth takes place in temperatures above 6ºC. It prefers calcareous water with a pH range of 6.5-10. It has a high tissue demand for both phosphorus and nitrogen. *Elodea nuttallii* is common and widespread over England up to a line roughly between the Ribble and Humber estuaries. Further north it is frequent in Lancashire and Cumbria but is absent from much of central northern and north-eastern England. In Wales its distribution is focused on mid-western and south-eastern parts of the country with sporadic occurrences elsewhere. In Scotland it occurs mostly in the south west and in the Central Lowlands. There is one record from North Uist and scattered records around the Moray Firth and Ballachulish but is otherswise absent from the Highlands and Islands (see distribution map at http://data.nbn.org.uk/gridMap/gridMap.jsp?allDs=1&srchSpKey=NHMSYS0000458329).
	Impacts	**RESPONSE**	**UNCERTAINTY**	**COMMENT**

2.5	How important is economic loss caused by the organism within its existing geographic range?	moderate - 2	LOW - 0	The main impact is likely to be on recreational activities, especially boating, watersports and angling. It may impede drainage if numbers of plants are high. In its native range, it is not considered a pest. In its introduced range it has the potential to develop into dense submerged beds, which prevent the use of water for recreational and professional purposes, (Larson, 2003) navigation and port infrastructure (CPS-SKEW, 2008). The plant can also clog and impede drainage waterways.
2.6	Considering the ecological conditions in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, livestock health and production, likely to be? (describe) in the Risk Assessment area, how serious is the direct negative economic effect of the organism, e.g. on crop yield and/or quality, likely to be?	minor - 1	LOW - 0	No evidence of economic problems in terms crop production or livestock health. Not enough information available to make an assessment.
2.7	How great a loss in producer profits is the organism likely to cause due to changes in production costs, yields, etc., in the Risk Assessment area?	minimal - 0	LOW - 0	Interference with recreation, primarily sailing and other water sports, fishing restrictions.
2.8	How great a reduction in consumer demand is the organism likely to cause in the Risk Assessment area?	minimal - 0	LOW - 0	No information.
2.9	How likely is the presence of the organism in the Risk Assessment area to cause losses in export markets?	very unlikely - 0	LOW - 0	The plant is imported into the risk assessment area.
2.10	How important would other economic costs resulting from introduction be? (specify)	moderate - 2	LOW - 0	Interference with recreation, primarily boating, water sports and angling.
2.11	How important is environmental harm caused by the organism within its existing geographic range?	minimal - 0	LOW - 0	Does not cause environmental harm in North America. Indeed it is considered to be 'Threatened' in Kentucky and of 'Special Concern' in Tennessee (USDA-NRCS 2009).
2.12	How important is environmental harm likely to be in the Risk Assessment area?	major - 3	LOW - 0	*Elodea nuttalli* can have a general negative impact on the functioning of aquatic ecosystems and it will outcompete native aquatic plants as well as the naturalised *Elodea canadensis* which grows in similar habitats. It may take 1-3 growing seasons to assume pest proportions at a site, with such proportions being maintained for a decade or more. Stem fragments have high survival rates which allow them to be dispersed over long distances. There are still many suitable habitats where it could become invasive, particularly in north-eastern England, southern, central and eastern Scotland and eastern Wales. Conversely in some situations it may be valued e.g., for providing structural diversity to a habitat or as a food source for wintering wildfowl. E. nuttallii can become dominant in altered or created aquatic systems, especially when bicarbonate, reduced iron, and phosphorus are plentiful (Thiébaut and Nino, 2009). E. nuttallii tends to dominate native macrophyte communities, which may lead to their local extinction. This species may also have a significant impact on protected sites. It often forms dense, monospecific stands and displaces other aquatic plants from many localities (Simpson 1984, 1990, Barrat-Segretain 2005). Elodea nuttallii and E. canadensis have shading effects during phases of rapid growth and mass occurrence. The plants compete with and displace indigenous vegetation, thus reducing biodiversity (Josefsson and Andersson, 2001). Dense populations of plants reduce the water movement, cut off light, produce anoxic conditions and trap sediments in the system. Plant decomposition at the end of the growing season typically induces a secondary eutrophication leading to the accumulation of end products toxic to many plants. In Japan, it has been reported that the biomass of native plants declined drastically after the invasion of Elodea nuttallii (Kadono, 2004). E. nuttallii is also known to replace other invasive species as the dominant species in an impacted ecosystem; it has replaced Elodea canadensis at many sites due to increased eutrophication, and is in turn being replaced by Lagarosiphon major. Impacts have also been recorded on invertebrate communities.
2.13	How important is social and other harm caused by the organism within its existing geographic range?	minimal - 0	LOW - 0	Not known to cause harm within its existing geographical range and considered to be of conservation concern in some states in the USA.
2.14	How important is the social harm likely to be in the Risk Assessment area?	major - 3	LOW - 0	Social harm will be through interference with recreation, primarily boating, water sports and angling. It is a submerged plant, and just like E. canadensis it forms large and dense stands that interfere with boating, fishing and adversely affect recreation activities.
2.15	How likely is it that genetic traits can be carried to native species, modifying their genetic nature and making their economic, environmental or social effects more serious?	very unlikely - 0	LOW - 0	*Elodea nuttallii* only reproduces vegetatively so there is minimal risk of genetic traits being carried to native species. Other genera in the Hydrocharitaceae native or introduced (indicated by *) into the risk assessment area *Egeria*, Hydrilla, Hydrocharis, Lagarosiphon*, Najas, Stratiotes* and *Vallisneria**. It is very unlikely to cross with any of these and no intergeneric hybridisation between them has been recorded .
2.16	How probable is it that natural enemies, already present in the Risk Assessment area, will have no affect on populations of the organism if introduced?	very likely - 4	LOW - 0	There are no natural enemies in the risk assessment area.

2.17	How easily can the organism be controlled?	difficult - 3	LOW - 0	*Elodea nuttallii* is easily cut and controlled for short periods (1-2 months in summer) by mechanical methods. Cutting early in spring may delay the onset of the peak biomass period. It is susceptible to chemical control to dichlobenil applied in spring before the plant is fully grown. Terbutryn and diquat are also useful. Chemical control will give effective eradication of the plant for between 2 and 3 years. The use of herbivorous Grass Carp is appropriate as a biological control method. Common Carp, and other bottom feeding fish, which create turbid water, can also be effective in preventing regrowth of the plant after mechanical removal or control by a herbicide. *Elodea nuttalli* may also susceptible to shade.
2.18	How likely are control measures to disrupt existing biological or integrated systems for control of other organisms?	unlikely - 1	LOW - 0	This species forms a monospecific stand, so the impacts of any control measure will be minimal.
2.19	How likely is the organism to act as food, a host, a symbiont or a vector for other damaging organisms?	very unlikely - 0	LOW - 0	None known.
2.20	Highlight those parts of the endangered area where economic, environmental and social impacts are most likely to occur		LOW - 0	Lowland ponds, lakes, canals, slow-moving rivers and streams and, especially, made-made water bodies such as drainage channels and gravel pits.
	Summarise Entry	very likely - 4	LOW - 0	The plant has been growing in the risk assessment area since 1966. Entry has been by deliberate introduction through the horticultural and aquarium trades, disposal of cultivated material and subsequent natural spread. Horticultural trade in this species has now declined.
	Summarise Establishment	very likely - 4	LOW - 0	The plant is widely established in the risk assessment area.
	Summarise Spread	rapid - 3	LOW - 0	Different studies have established that E. nuttallii is probably in an expansion phase in Europe and is likely to spread to new areas (Simpson 1984; Thiébaut et al. 1997; Barrat-Segretain 2001, Larson 2007), and it should be regarded as having a high risk of being invasive and must be strongly recommended as a priority target for eradication or control in new sites (Thiébaut et al. 1997). It also has the potential to move into areas currently uncolonised, particularly in north-eastern England, Scotland north of the Central Lowlands and Wales, in either new habitats or in habitats currently occupied by *E. canadensis* , which it displaces.
	Summarise Impacts	moderate - 2	LOW - 0	The main impact is on water-based recreational activities and possible impedence of drainage.
	Conclusion of the risk assessment	MEDIUM -1	LOW - 0	Widely established, with the potential to invade either new habitats or in habitats currently occupied by *E. canadensis* , which it displaces.
	Conclusions on Uncertainty		LOW - 0	

References

Anderberg A, 1992. Nuttall waterweed, *Elodea nuttallii* , a new macrophyte in the Swedish flora (in Swedish with English summary). Svensk Botanisk Tidskrift, 86:43-45.

Anon. (2004). Information sheet 25: *Elodea nuttallii* , Nuttall's Pondweed. CAPM, CEH Wallingford, Crowmarsh Gifford, Wallingford, Oxon. http://www.nerc-wallingford.ac.uk/research/capm/pdf%20files/25%20Elodea%20nuttallii.pdf

Barrat-Segretain MH, 2001. Invasive species in the Rhône River floodplain (France): replacement of *Elodea canadensis* Michaux by *E. nuttallii* St. John in two former river channels. Archiv für Hydrobiologie, 152:237-251.

Barrat-Segretain MH, 2005. Competition between invasive and indigenous species: impact of spatial pattern and developmental stage. Plant Ecol., 180:153–160.

Barrat-Segretain MH, Elger A, 2004. Experiments on growth interactions between two invasive macrophyte species. Journal of Vegetation Science, 15:109-114.

Barrat-Segretain MH, Elger A, Sagnes P, Puijalon S, 2002. Comparison of three life-history traits of invasive *Elodea canadensis* Michx. and *Elodea nuttallii* (Planch.) H. St. John. Aquatic Botany, 74(4): 299-313

Barrat-Segretain, M.-H.; Bornette, G. (2000). Regeneration and colonization abilities of aquatic plant fragments: Effect of disturbance seasonality. Hydrobiologia 421(1-3): 31-39.

Barrat-Segretain, M.-H.; Cellot, B., (2007). Response of invasive macrophyte species to drawdown: The case of *Elodea* sp. Aquatic Botany. 87(4): 255-261.

Barrat-Segretain, M.-H.; Elger, A., Sagnes, P. & Puijalon, S. (2002). Comparison of three life-history traits of invasive *Elodea canadensis* Michx. and *Elodea nuttallii* (Planch.) H. St. John. Aquatic Botany. 74(4): 299-313.

Best EPH, Woltman H, Jacobs FHH, 1996. Sediment-related growth limitation of *Elodea nuttallii* as indicated by a fertilization experiment. Freshwater Biol., 36:33-44.

Bowmer, K,H, Jacobs, S.W.L. & Sainty, G.R. (1995). Identification, biology and management of *Elodea canadensis* , Hydrocharitaceae. J. Aquat. Plant Manage. 33: 13-19

Branquart E, (Ed.) 2007. Alert, black and watch lists of invasive species in Belgium. Elodea nuttalli - Nuttall's waterweed Harmonia version 1.2, Belgian Forum on Invasive species. http://ias.biodiversity.be

BSBI (2009a). BSBI Database. http://rbg-web2.rbge.org.uk/BSBI/intro.php

BSBI (2009b). BSBI Maps Scheme: Hectad Maps. http://www.bsbimaps.org.uk/atlas/main.php

Cook CDK, 1987. Dispersion in aquatic and amphibious vascular plants. In: Crawford RMM, ed. Plant Life in Aquatic and Amphibious Habitats. Special Publication British Ecological Society, No. 5. Blackwell Scientific Publications, Oxford, England, 179–190.

Cook CDK, Urmi-König K, 1985. A revision of the genus *Elodea* (Hydrocharitaceae). Aquat. Bot., 21:111-156.

Cook, C.D.K. & Ürmi-König, K (1985). A revision of the genus *Elodea* (Hydrocharitaceae). Aquatic Botany 21: 111-156.

CPS-SKEW, 2008. Black List and Watch List. Swiss Commission for Wild Plant Conservation CPS/SKEW. http://www.cps-skew.ch/english/black_list.htm

Dadds, N. & Bell (Scott-Wilson), S. (2007). Invasive Non-Native Plants Associated with Fresh Waters. A Guide to their Identification. Plantlife, Royal Botanic Garden Edinburgh, Scottish Natural Heritage, Scottish Environment Protection Agency, Scottish Water.

DAISIE, 2009. Elodea nuttallii. Delivering Alien Invasive Species Inventories for Europe, DAISIE. European Invasive Alien Species Gateway. www.europe-aliens.org/

Elger A, Bornette G, Barrat-Segretain MH, Amoros C, 2004. Disturbances as a structuring factor of plant palatability in aquatic communities. Ecology, 85:304-311.

Erhard D, Gross EM, 2006. Allelopathic activity of Elodea canadensis and Elodea nuttallii against epiphytes and phytoplankton. Aquat. Bot., 85:203–211

Erhard D, Pohnert G, Gross EM, 2007. Chemical defense in Elodea nuttallii reduces feeding and growth of aquatic herbivorous Lepidoptera. Journal of Chemical Ecology, 33(8):1646-1661.

Ikushima I, Kabaya H, 1965. A newly introduced aquatic plant, *Elodea occidentalis,* in Lake Biwa, Japan. J.Jpn. Bot., 40:57-64.

James, C.S., Eaton, J.W. & Hardwick, K. (1999). Competition between three submerged macrophytes, *Elodea canadensis* Michx, *Elodea nuttallii* (Planch.) St. John and *Lagarosiphon major* (Ridl.) Moss. Hydrobiologia 415:35-40

Josefsson M, Andersson B, 2001. The environmental consequences of alien species in the Swedish lakes Malaren, Hjalmaren, Vanern and Vattern. Ambio, 30:514-521.

Kadono Y, 2004. Alien Aquatic Plants Naturalized in Japan: History and Present Status. Global Environmental Research, 8(2):163-169.

Keith Davenport in Davis, 2009. The 15 plants killing our countryside. The Observer, Sunday 17 May 2009.

Lansdown RV, 2008. A field guide to the riverine plants of Britain and Northern Ireland. Including selected vascular plants, bryophytes, lichens and algae Environment Agency, Thames Region. 316pp

Larson D, 2003. Predicting the threats to ecosystem function and economy of alien vascular plants in freshwater environments. Rapport 2003:7. Department of Environmental Assessment Swedish University of Agricultural Sciences, Uppsala. 31 pp.

Larson D, 2007. Non-indigenous Freshwaters Plants. Patterns, Processes and Risk Evaluation. Doctoral Thesis, Swedish University of Agricultural Sciences, Uppsala.

Lemoine DG, Barrat-Segretain MH, et al., 2009. Morphological and chemical changes induced by herbivory in three common aquatic macrophytes. International Review of Hydrobiology, 94(3):282-289.

Lodge DM, 1991. Herbivory on freshwater macrophytes. Aquat. Bot., 41:195–224.

Mesterházy A, Király G, Vidéki R, Steták D, Csiky J, 2009. Actual report on spread of invasive macrophytes in Hungary. In: Pieterse A, Rytkönen AM, Hellsten S, eds. Proceedings of the 12th European Weed Research Society Symposium, Jyväskylä, Finland, 24-28 August 2009.

Nagasaka M, 2004. Changes in biomass and spatial distribution of *Elodea nuttallii* (Planch.) St. John, an invasive submerged plant, in oligomesotrophic Lake Kizaki from 1999 to 2002. Limnology, 5:129–139.

Newman RM, 1991. Herbivory and detritivory on freshwater macrophytes by invertebrates: a review. J. North Am. Benthol. Soc., 10:89–114.

Newman, JR (2009). Information sheet 25: Elodea nuttallii, Nuttall's Pondweed. Centre for Ecology & Hydrology. 2 pp. http://www.ceh.ac.uk/sci_programmes/AquaticPlantManagement.html

Nichols SA, Shaw BH, 1986. Ecological life histories of the three aquatic nuisance plants, Myriophyllum spicatum, Potamogeton crispus and Elodea canadensis. Hydrobiologia, 131:3–21.

Oťaheľová H, Valachovič M, 2002. Effects of the Gabčíkovo hydroelectric-station on aquatic vegetation of the Danube river (Slovakia). Preslia, 74:323–331.

Ozimek T, Van Donk E, Gulati RD, 1993. Growth and nutrient uptake by two species of *Elodea* in experimental conditions and their role in nutrient accumulation in a macrophytedominated lake. Hydrobiologia, 251:13–18.

Preston CD and Croft JM, 1997. Aquatic plants in Britain and Ireland. Harley Books, Colchester for the Environment Agency. Institute of Terrestrial Ecology and the Joint Nature Conservation Committee.

Rodwell, J. S. (1998). British Plant Communites: Aquatic Communities, Swamps and Tall-Herb Fens. Nature Conservancy Council (Great Britain), Joint Nature Conservation Committee (Great Britain).

Sârbu A, Smarandache D, Janauer G, Pascale G, 2006. *Elodea nuttallii* (Planchon) St. John – a competitive hydrophyte in the Romanian Danube river corridors. In: Proceedings 36th International Conference of IAD. Austrian Committee DanubeResearch / IAD, Vienna, 4-8 September 2006.

Simpson DA, 1984. A short history of the introduction and spread of Elodea in the British Isles. Watsonia, 15:1-9.

Simpson DA, 1990. Displacement of *Elodea canadensis* Michx by *Elodea nuttallii* (Planch.) H. St John in the British Isles. Watsonia, 18:173-177.

Simpson, D.A. (1984). A short history of the introduction and spread of *Elodea* Michx in the British Isles. Watsonia 15: 1-9.

Simpson, D.A. (1986). Taxonomy of *Elodea* Michx. In the British Isles. Watsonia 16: 1-14.

Simpson, D.A. (1988). Phenotypic plasticity of *Elodea nuttallii* (Planch.) H. St John and *Elodea canadensis* Michx in the British Isles. Watsonia 17: 121-132.

Simpson, D.A. (1990). Displacement of *Elodea canadensis* Michx. by *Elodea nuttallii* (Planch.) St John in the British Isles. Watsonia 18: 173-177.

Thiébaut G, De Nino F, 2009. Morphological variations of natural populations of an aquatic macrophyte Elodea nuttallii in their native and in their introduced ranges. Aquatic Invasions, 4(2):311-320.

Thiébaut G, Muller S, 1999. A macrophyte communities sequence as an indicator of eutrophication and acidification level in weakly mineralised streams in north-eastern France. Hydrobiologia, 410:17–24.

Thiébaut G, Rolland T, Robach F, Tremolieres M, Muller S, 1997. Some consequences of the introduction of two macrophyte species, *Elodea canadensis* Michaux and *Elodea nuttallii* St. John, in continental aquatic ecosystems: example of two areas in the north-east of France: Alsace plain and northern Voges. Bull. Fr. Peche Piscicult., 344/345:441–452.

Thiébaut, G. (2005). Does competition for phosphate supply explain the invasion pattern of *Elodea* species? Water Research 39(14): 3385-3393

USDA, NRCS (2009). *Elodea nuttallii* Western waterweed. The PLANTS Database (http://plants.usda.gov, 26 November 2009). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

USDA-ARS, 2009. National Genetic Resources Program. Germplasm Resources Information Network - (GRIN). National Germplasm Resources Laboratory, Beltsville, Maryland

Van Donk E, Otte A, 1996. Effects of grazing by fish and waterfowl on the biomass and species composition of submerged macrophytes. Hydrobiologia, 340:285–290.

Vanderpoorten A, Lambinon J, Tignon M, 2000. Morphological and molecular evidence of the confusion between *Elodea callitrichoides* and *E. nuttallii* in Belgium and Northern France. Belgian Journal of Botany, 133:41-52.

Wade, P. M. (1999). The impact of human activity on the aquatic macroflora of Llangorse Lake, South Wales. Aquatic Conservation. 9(5): 441-459.

Wittenberg R, 2005. An inventory of alien species and their threat to biodiversity and economy in Switzerland. CABI Bioscience Switzerland Centre report to the Swiss Agency for Environment, Forests and Landscape. The environment in practice no. 0629: 155p.

Wu ZB, Gao YN, et al., 2009. Allelopathic effects of phenolic compounds present in submerged macrophytes on Microcystis aeruginosa. Allelopathy Journal, 23(2):403-410.